

INSTITUTE OF TERRESTRIAL ECOLOGY

(NATURAL ENVIRONMENT RESEARCH COUNCIL)

Report to Directorate General XVI (European Commission)

DGXVI Contract

ITE Project T02086D1

**GENERALISING THE LAND COVER  
MAP OF GREAT BRITAIN TO  
CORINE LAND COVER BY SEMI-  
AUTOMATED MEANS**

**First interim report**

D.S. Edmundson, F. F. G9rard, N. J. Brown, and R. M. Fuller



European Commission



**European Environment Agency**

**Putting Information To Work**

Institute of Terrestrial Ecology  
Monks Wood  
Abbots Ripton  
Huntingdon  
Cambridgeshire PE17 2LS

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## **EXECUTIVE SUMMARY**

1. The European Commission (EC) programme 'Co-ordination of Information on the Environment' (CORINE) includes a major project to map the land cover and land use of member states.
2. The CORINE Land Cover map, generally produced in the late 1980's - early 1990's by visual interpretation and manual digitising, shows 44 cover types, in vector format (i.e. as digital map outlines) at 1:100 000 scale, with a minimum mappable unit of 25 ha.
3. The Land Cover map of Great Britain (LCMGB) of 1988-90 gives a raster (i.e. grid-based) map which records cover on 25 m cell size, identifying 25 cover-types, with a minimum mappable unit of 0.125 ha, showing landscape patterns at field-by field scale.
4. This projects aims to generalise the LCMGB to CORINE Land Cover format by using a semi-automated generalisation procedure developed in 1994 by ITE.
5. The generalisation procedure has been made operational. It has been adapted to run on ArcView and made more efficient.
6. Outputs have been evaluated by the production team, Cristina Seabra of the ETC/LC Technical Unit, and the results presented to the CLCGB Advisory Group.
7. Further refinement of the procedures will be implemented, including the updated generalisation criteria specified by the European Environment Agency for generalisation to CORINE Land Cover.
8. Operational production of CORINE Land Cover of Great Britain is planned to start in a month's time

# 1 INTRODUCTION

1.1 The European Environment Agency (EEA) was launched by the European Union (EU) in 1993 with a mandate to co-ordinate and put to strategic use information of relevance to the protection and improvement of Europe's environment. The Agency carries out its tasks in co-operation with a European Information and Observation Network (EIONET). EIONET consists of national networks, organised by the Agency to help it retrieve information, and produce efficient and timely information on Europe's environment. To execute particular tasks, institutions or organisations have been contracted as European Topic Centres (ETC). There are today ETCs for Air Emissions, Air Quality, Catalogue of Data Sources, Inland Waters, Land Cover, Marine & Coastal Environment, Nature Conservation and Soil. The ETC on Land Cover (ETC/LC), led by the Environmental Satellite Data Centre (MDC) in Sweden, was established to provide accurate data on land cover in Europe, corresponding to needs across a wide range of applications.

1.2 A key activity of ETC/LC has been the completion of a European-wide inventory of land cover in 44 classes. This takes the form of a digital cartographic product, at a scale of 1:100 000. The inventory has been compiled, mostly in the late 1980's - early 1990's, using methods developed within the CORINE (Co-ordinating Information on the European Environment) experimental programme, undertaken by the Environment Directorate (DGXI) of the European Commission between 1980 and 1985. A major task of ETC/LC has been to develop and complete the Land Cover database begun within the CORINE programme. Today the CORINE land cover data base is operationally available for the greater part of the 3.5 million km<sup>2</sup> covered by the European Union and progress is being made, through the PHARE programme, in the production of maps to CORINE standards for the former Soviet Union states.

1.3 The land cover of Great Britain has been mapped in detail by the Institute of Terrestrial Ecology using remotely-sensed data. The British land cover map differs from CORINE in several respects, including its spatial resolution, the land cover classes mapped and the method of production.

1.4 The CORINE Land Cover map has generally been produced by visual interpretation of hard copy satellite images followed by manual digitising to give computer maps which show 44 cover types, as digital map outlines, in vector format at 1:100 000 scale, with minimum mappable units of 25 ha. The Land Cover Map of Great Britain (LCMGB) is a raster or grid-based product which records 25 cover-types, on 25 m grid, with minimum mappable units of 0.125 ha, showing landscape patterns at the field-by-field scale.

1.5 A pilot study has successfully demonstrated semi-automated procedures, which can be used to convert the LCMGB to CORINE specifications. These procedures involve generalisation from the 25 m resolution, reassignment of LCMGB classes to the CORINE categories, generation of CORINE mosaic classes from heterogeneous regions, and use of knowledge-based operations to add relevant land use information.

1.6 There are significant financial benefits of automated conversion of the LCMGB to CORINE format, a process which is estimated to cost about 15% the price of new CORINE mapping of Britain. Conversion ensures that CORINE land cover data for Britain are calibrated against the existing national map and against proven ground reference data available from Countryside Survey 1990. The approach also ensures that information on CORINE land cover in Britain is entirely

consistent with the national data-set and with the large number of uses to which these data have already been put.

1.7 This project aims at converting the existing Land Cover Map of Great Britain to CORINE Land Cover format by semi-automated means. The work is jointly funded by the Directorate-General XVI for regional policy and cohesion (DGXVI) of the European Commission (EC) and the Department of Environment and Transport, UK (DETR). The work is being carried out by the Institute of Terrestrial Ecology, UK (ITE).

1.8 The generalisation procedure and the final CORINE outputs will be evaluated by the Technical Advisory Group of the European Topic Centre/Land Cover which is represented by Cristina Seabra of CNIG, Portugal.

1.9 The Advisory Group will be flexible in membership of meetings. The business of the Advisory Group is a two way process, mainly for ITE to assure deliverables are on time and of the quality required; and to advise or seek advice if and when problems arise. The projects advisory group members are:

Dr Andrew Stott	Department of the Environment, Transport and Regions
Dr Michael Alb<s	Commission of the European Communities, DGXVI
Dr Chris Steenmans	European Environment Agency
Dr Vanda Perdigvo Centre	Commission of the European Communities, Joint Research
Dr Stuart Gardiner	Scottish Office

## 2 METHODS

The generalisation methodology used to produce CORINE Land Cover was developed as part of a feasibility study in 1994. It is a semi-automatic procedure and comprises the following main steps:

- Removal of very small parcels;
- Extraction of 25 ha parcels with direct CORINE equivalence;
- Clustering of smaller parcels;
- Analysis and classification of mosaic parcels;
- Assignment of remaining small parcels to the most appropriate neighbouring class;
- Overlay onto the satellite images to check outputs;
- Use of 'exogenous' data and expert interpretation to identify CORINE land uses;
- Smoothing of polygon boundaries;

The operation of these methods is documented in the ITE report to the Department of the Environment (Fuller & Brown, 1994) and further described in published papers by Fuller & Brown (1996) and Brown *et al.* (1996) with methodological refinements outlined by Gerard *et al.* (1996).

The procedure, initially designed to use ArcInfo and ArcGrid functions, has been built into ArcView processes as a sequence of scripts which produce consistent outputs, with the minimum of interactions (see further). However, results require inspection and fine-tuning of methods making some stages iterative. Other stages, especially the interpretation of CORINE's land use classes (e.g. airports, recreation areas) will need some interactive editing.

The above stages will be applied to subsections based on 100 km square tiles of the LCMGB (with overlaps between subsections to ensure satisfactory subsequent edge matching). The following stages apply to output tiles:

**Aggregation:** 100 km tiles of the CORINE Land Cover of Britain will be assembled into continuous, edge-matched vector data for all Britain

**Validation:** samples of output maps will be validated by comparison with equivalent samples mapped by conventional CORINE methods and by comparisons with ground reference data including those from Countryside Survey 1990.

**Measurements:** the differences between input and output maps, i.e. the effects of generalisation, will be measured; also summary statistics will be provided giving tabulations of CORINE statistics for Britain, England, Scotland and Wales and for Regions

**Output of 1 km data:** Map data will be summarised as cover per class per 1 km square and built into a PC-based information system

### 3 METHODOLOGICAL IMPROVEMENTS AND ADDITIONS

The following paragraphs describe how the original generalisation procedures that were designed for use in Arc Info have been adapted to run in ArcView. This adaptation to ArcView incorporated improvements in methodology as well as efficiency. A detailed listing of the ArcView functions used for each generalisation step is included in the appendix.

#### 3.1 Grid or Vector

ArcView handles Grid files in the same general manner as ArcGrid. The original process involved generalising a given LCMGB tile using a combination of ArcInfo and ArcGrid procedures on a Unix workstation. All processes were command-driven by typing in set functions at each stage of the conversion. The generalisation also involved five intermediate conversions from raster-to-vector and vice versa which were tedious, time consuming and had a weakness in the limited number of vectors that could be handled at any one time by ArcInfo. As the test area was relatively small in the first instance, it was not limited by numbers of polygons so the generalisation process was allowed to run smoothly. However, an increase in the test area to 50 km square of land, containing a greater variety of LCMGB landclasses, resulted in a total number of polygons exceeding the then 100 000 polygon limit of ArcInfo. This in turn led to a need for segmenting the land tile into a number of smaller sections, which introduced subsequent problems of edge matching.

ArcView has much the same functionality as ArcGrid but its object-oriented macro programming language 'Avenue' allows the user more control over functions (such as grid zonal functions, see below) and the linking together of various functions into sub-routines. The sub-routines can also be accessed via customised menu systems.

The initial changes made to the generalisation system were aimed at keeping the data in Grid format in order to avoid the imposed 100,000 polygon limit. This would also speed up the generalisation

process by reducing the need for conversion between raster and vector formats and between systems. It would not compromise the quality of outputs or their correspondence with CLC; indeed, the refinements help to improve these.

### **3.2 Preliminary Thematic generalisation**

The 25 LCMGB classes were simplified to use only the broad types needed to define CLC classes and mosaics.

### **3.3 Removal of small parcels and extraction of 25 ha parcels with direct CORINE equivalence**

Instead of using ArcInfo 'eliminate' or 'dissolve' to remove polygons < 2 ha the 'region group' and 'nibble' commands were used in ArcView to return a similar result in Grid format (see Figure 3.1).

Growing polygons is a GIS procedure which has been developed for the CORINE 'outliers'. By growing and shrinking regions, small clusters of regions can be merged and small isolations in grid zone boundaries can be 'filled in'. This process, involving 'cost distance mapping' and 'neighbourhood sum' functions, is essentially unaltered except that the process is now fully automated. One click on the generalisation menu button executes the growing/shrinking procedure on all classes and creates a series of grid layers each of which contains the results of a particular class. Thus running this process in ArcView reduces the time required to grow a single class in a 100 km square tile from well over 2 hours to around 10 minutes. This is significant considering that all 25 classes in the grid have to be grown/shrunk.

The merging of the grown class grids into a single dataset is time-consuming. The sequence of merging determines the priority of classes, with those merged later overwriting earlier class parcels where both have grown to bridge the same gap. The classes are thus merged in different orders of priority in the various UK regions depending on the underlying dominant class and the less frequent classes which we may want to retain for cartographic generalisation reasons. In the original process this involved writing an ordered list of the class grids in an ArcGrid command. In ArcView a macro has been written that merges grids depending on the order in which they appear in a view, thus speeding up the process and making it more flexible.

**Note:**

The function **'REGION GROUP'** groups all adjacent orthogonal pixels of the same class into regions (GRID B) (see

Figure 3.1). Conditional rules are then applied on the regions based on their size (i.e. number of pixels). If regions are less than a given size (i.e. in this case 2 hectares) all pixels in the region are given a null value (corresponding to 0 in

Figure 3.1). If regions are greater than a given area they retain the class of the original grid (i.e. GRID A). The result is a mask grid (GRID C) which can be used in the nibble process.

The function **'NIBBLE'** replaces the pixels of a Grid (GRID A) that were given null values in the Mask Grid (GRID C) with the values of their nearest neighbours (see Figure 3.1).

These procedures are similar to the ones described in detail in Brown et al. (1996) for ArcGrid.

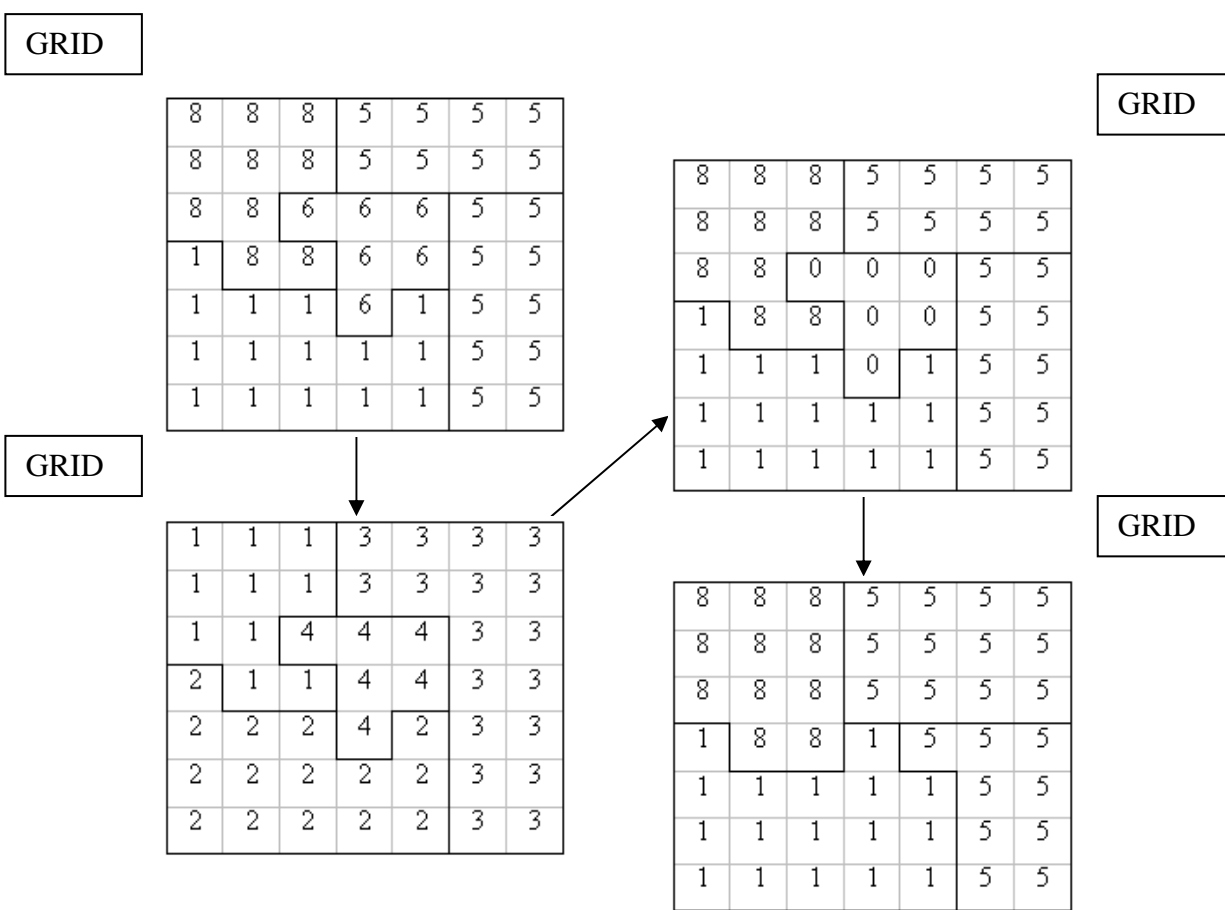


Figure 3.1 The region group and nibble process.

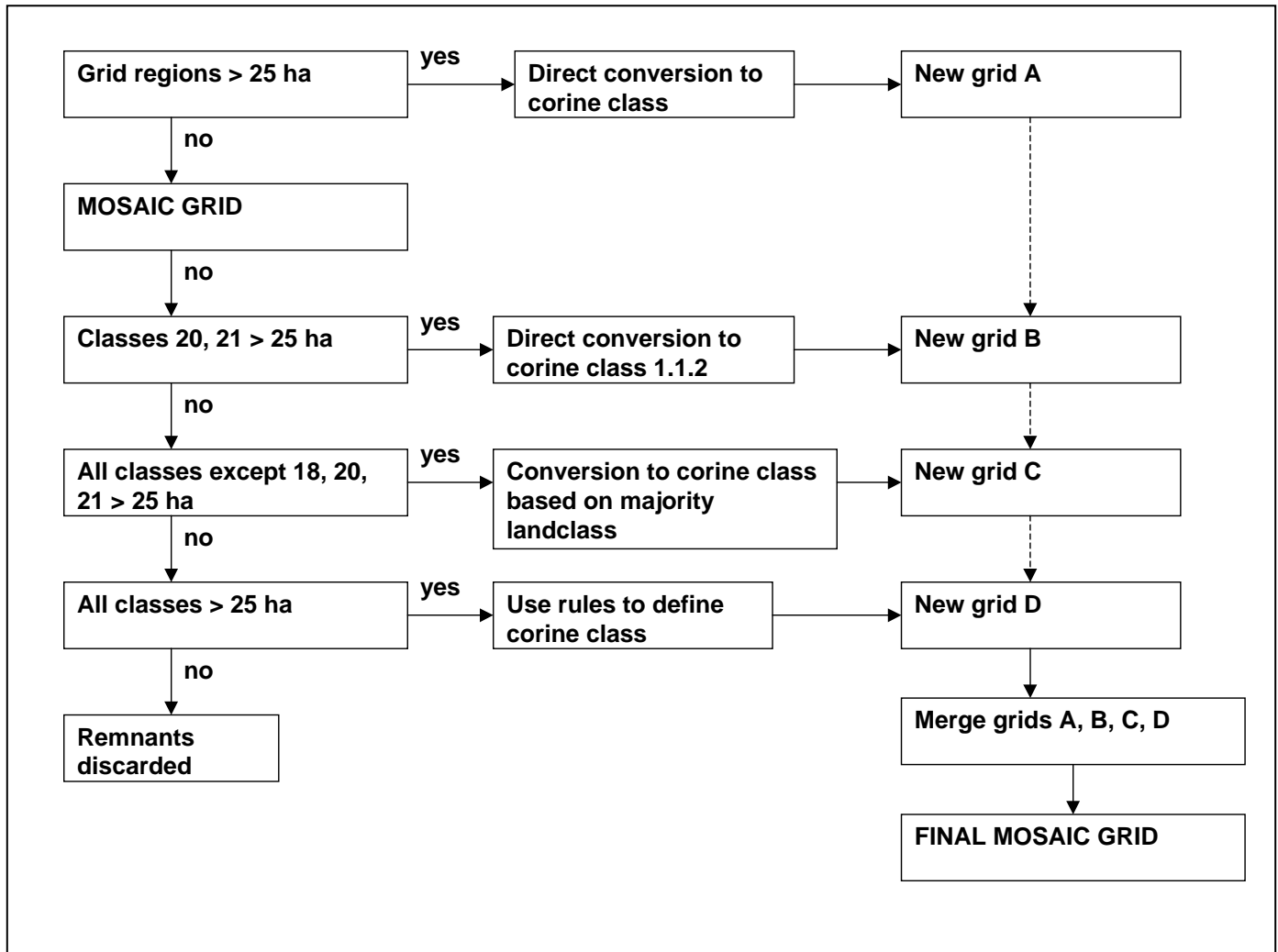
### 3.4 Clustering of smaller parcels and analysis and classification of mosaic parcels

The majority of changes made to the generalisation process have been in the final stage of the analysis and classification of 'mosaic' or composite polygons. In the original process this was



essentially an interactive process involving the user visually determining the composition of mosaics – a laborious method suffering from the problems of human error and subjectiveness.

Using zonal geometry and zonal statistics functions in ArcView it is possible to calculate the exact composition of mosaics in terms of % class composition. The results are stored in a table and queried using the given CORINE rules to determine the correct landcode and thus Corine code. The whole process of mosaics has also been automated. A schematic overview of the procedure is shown in Figure 3.2.



**Figure 3.2** Schematic overview of the mosaic process.

### 3.5 Use of 'exogenous' data and expert interpretation to identify CORINE land uses

Certain CORINE classes cannot be defined directly from computer algorithms. Features such as Port Areas, Airports, Sport and Leisure facilities, Dump Sites and Mineral Extraction Sites require extra. A key source is the Batholemews point data set. One of the many drawbacks of this dataset is its crude spatial accuracy. This dataset was designed to be used at 1:250000 and when overlayed on to the LCMGB, point features such as golf courses may show positional inaccuracies or displacements up to 200m. However on the majority of occasions the golf course or feature in question can be

easily defined based on its typical shape or patterns. One method proposed is to manually digitise on top of the LCMGB and overlay these vectors at the beginning of the generalisation process (i.e. prior to removing polygons less than 2 hectares). These digitised polygons would be given priority throughout the generalisation process.

## **4 THE WAY FORWARD**

### **4.1 Further methodological improvements**

The generalisation method successfully converts the LCMGB into CORINE Land Cover. However discussions held at the first technical evaluation meeting identified areas where further refinement of the methodology may improve generalisation. Moreover, a manuscript defining mapping criteria for generalisation to CORINE, has recently been drafted for later publication by the EEA. The following planned changes aim at improving the generalisation method while making it comply with the EEA generalisation rules and criteria.

#### ***4.1.1 Extraction of 25 ha parcels with direct CORINE equivalence***

Parcels will be allowed to grow by a greater increment than initially planned. Thus, more of the small parcels belonging to typically fragmented cover classes are allowed to join to form parcels  $\geq 25$  ha. The rules defining the sequence of priority in which classes are merged after growing and shrinking will be reviewed. The rules will use class statistics on parcel sizes and fragmentation, and will incorporate the criteria included in the EEA generalisation manuscript.

#### ***4.1.2 Analysis and classification of mosaic parcels***

When heterogeneous parcels are being classified into CORINE mosaic classes, criteria will be incorporated which include information on parcel sizes and fragmentation, using the rules defined by the EEA manuscript.

#### ***4.1.3 Assignment of remaining small parcels to the most appropriate neighbouring class***

The small parcels, that remain after the classification of mosaic parcels, were originally dissolved, 'Nibbled' into the adjacent parcels by using a combination of 'nearest-neighbour' and 'cost-distance' rules. The 'nearest-neighbour' rule tends to split the parcel up into sections which are dissolved into the adjacent parcels, creating new boundaries. In cases where a small parcel has more thematic affinity with one of its neighbouring parcels, this approach is not appropriate. The procedure will be altered to include a form of thematic generalisation. The removal of small parcels will first be based on their thematic content. A small parcel is joined with the neighbouring parcel that has the highest thematic similarity or affinity. If the small parcel has no thematic affinity with any of its neighbours or is an island surrounded by a single cover type, 'Nibble' is applied.

#### ***4.1.4 Aggregation***

Aggregation or edge-matching of the generalised UK sub-sections will be improved by making the adjacent sub-sections overlap. This approach will be tested and refined if necessary.

#### ***4.1.5 Other refinements***

Other refinements were discussed by the Advisory Group and the joint conclusions are given in the minutes (Annex I).

## 4.2 Evaluation and calibration

The procedure developed to validate the CORINE Land Cover map is described in the CORINE technical guide. The method uses extensive field surveying and aerial photography to checking the accuracy of the CORINE Land Cover map product. The Land Cover Map of Great Britain is based on satellite imagery dated between 1989 and 1990. There is no substantial set of aerial photography available for that period and the size (1 km<sup>2</sup>) of the 508 Countryside Survey field samples collected in 1990 is inadequate for a validation exercise as described in the technical guide. Since the accuracy of the Land Cover Map of Great Britain is known to be between 80% to 85% (Fuller *et al.* In press) the way forward is to first minimise the difference between semi-automatic and manual generalisation outputs and then to evaluate the impact of the generalisation process itself.

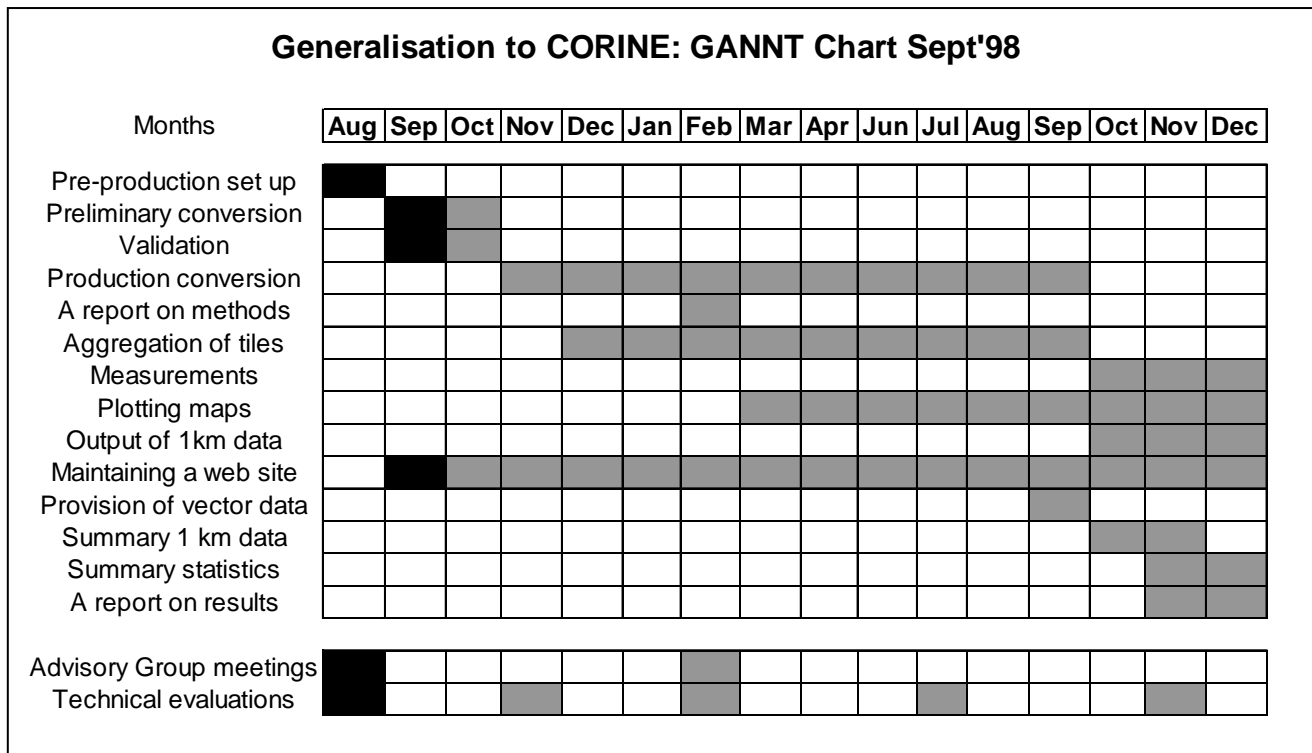
To minimise the difference between automated and manual generalisation outputs, a pilot section of the UK (area between Cambridge and Huntingdon) will be generalised using both methods. The final generalised products will be compared and the semi-automated procedure altered and improved until the difference between end-products are minimal. This will be carried out in close collaboration with the ETC/LC technical evaluation group.

The generalisation procedure will be evaluated by:

- (i) comparing the class statistics of the LCMGB with these of the CORINE Land Cover map,
- (ii) evaluating the changes in class statistics caused from one generalisation step to the other,
- (iii) following the generalisation procedure in a set of Countryside Survey 1km square and assess the impact of the overall process and the individual generalisation steps.

## 4.3 Timetable

The project is on schedule (see Figure 4.1). The generalisation method has been adapted for use in ArcView while at the same time made operational and efficient. Alteration to the method will not affect the key procedures and mainly entail changes in threshold values and rules. These changes will be carried out and tested in October so that production can start in November as scheduled. Outputs will only be affected insofar as these will be improved.



**Figure 4.1** Project GANNT chart showing progress (in black) marked against the time schedules of the original proposal

#### 4.4 Web page

A CLCGB web page has been designed and will soon be accessible on the internet. Links to the web page will be established from ITE, and ETC/LC pages. DETR and DGXVI will be invited to create a link to the CLCGB page. The web page will be updated on a monthly basis.

## references

**Fuller R M & Brown. N J.** 1994. *A CORINE map of Great Britain by automated means: a feasibility study*. Unpublished Institute of Terrestrial Ecology report to the Department of the Environment.

**Fuller, R. M. & Brown, N.** 1996. A CORINE map of Great Britain by automated means. Techniques for automatic generalization of the Land cover map of Great Britain. *International Journal of Geographical Information Systems*, **8**, 937-953.

**Gerard, F., Fuller, R.M., Brown, N.J., Jaakola, O., Ostling, M., Rosengren, M., Arozarena, A. & Bayarri, E.** 1996. *Work Programme 6. Research and Development. Task 6.3. Spatial Generalisation*. Final Report to the Joint Research Centre of the Commission of European Communities. Institute of Terrestrial Ecology.

**CORINE Advisory Group Meeting  
At ITE Monks Wood  
25 September 1998**

**MINUTES**

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<b>Present:</b>	Michael Alb<s Andrew Stott Stuart Gardiner Cristina Seabra Robin Fuller France G9rard Nigel Brown Derek Edmundson	<b>Apologies:</b>	Chris Steenman Vanda Perdigo
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The Advisory Group will be flexible in membership of meetings. The business of the Advisory Group is a two way process, mainly for ITE to assure deliverables are on time and of the quality required; and to advise or seek advice if and when problems arise.

The aim is for improvements in methods in October with validation and evaluation by November.  
**Action: CLCGB team.**

The GANNT is to be used to record progress through the programme. **Action: CLCGB team.**

There could be thematic generalisations closer to CLC classes rather than using all 25 LCMGB classes in the spatial generalisation. The team is to investigate. **Action: CLCGB team.**

Next month ITE to formalise polygon-growth and class-priority using Chris Steenman's manual as background information. **Action: CLCGB team.**

Robin Fuller to contact Bob Garland for urban vector outline Also LC change stats based on OS review cycle 87-92. **Action RF.**

Land Cover of Scotland identifies mineral sites and quarries - possibly also dump and industrial sites. Scottish Sports Council has a recreation site inventory. **Action Stuart Gardiner** to check availability of these for use in CLCGB [and CS2000?].

Proportional cover 1km<sup>2</sup> from CIS may offer other data. **Action: CLCGB team** to check

Geoff Phillips may have data for Wales. Robin Fuller to contact him. **Action: RF to contact GP.**

Technical issues should be agreed between ITE and CLC Technical Unit. **Action** (as needed) **CLCGB team and CNIG (C Seabra).**

AS pointed out that correspondence with FS should be checked. **Action CLCGB team** (later in the project).

Advisory Group agreed that validation should use Arable, Pastoral, Marginal and Upland tiles to compare visual interpretation with generalisation. RF suggested use of Cambridgeshire for initial tests. **Action RF / CLCGB team.** SG to identify an area in Scotland for later tests. AS to choose an area in Wales. **Action CLCGB team** (later in the project).

Validation to be reported at the March meeting. **Action RF.**

Map production: CLCGB team needs details of the official colors and patterns which are used to represent the CLC classes at level 3. **Action CS.**

Comments on the report to be done by Monday 5 October 1998. **Action ALL.**

### Outputs

- Selected examples of hard copy outputs at 1:100 000 to be provided for Michael Albas; plus 1 x 1:1 000 000 of all GB. **Action CLCGB team** (later in / end of project).
- Perhaps full set of maps and display material needed for DETR. **Action RF and AS to discuss.**
- Data summarised on a 250m grid - to be in public domain - distributed from MDC. **Action CLCGB team** (at end of project).
- Questions of wider distribution are for the March meeting. **Action - All to consider.**
- Final report to include an illustrated executive summary plus a detailed main report. **Action CLCGB team** (at end of project).
- CIS pilot outputs – examples for March meeting. **Action CLCGB team.**
- Web site will be updated on a monthly basis. **Action CLCGB team.**

A technical meeting is to take place in Early November 1999. **Action CLCGB team and C Seabra to arrange.**

The next meeting of the CLCGB Advisory Group is scheduled for March 1999.

Appendix 2. The sequence of ArcView functions used in the generalisation procedure.

### 1. Removal of areas < 2 hectares

This is a grid procedure which includes the following steps:

- i) **Region group** – Groups all pixels into parcels of a single CORINE class.
- ii) **Test for area > 2 hectares** – i.e. test to see whether each group is greater than 2 hectares. If the region is less than 2 hectares it is converted to a null class.
- iii) **Nibble** – reclass null values based on a nearest neighbour approach.

NB The function 'Region Group' is the grid equivalent of 'building a polygon topology' in vector. After 'Region Group' the pixels in a grid layer are seen as part of a region group of adjacent orthogonal pixels with the same class value.

### 2. Growing of grid classes

This is a grid procedure which includes the following steps:

NB each of the following steps is carried out on each class in the original grid.

- i) **Creation of cost grid** – all values other than null values are given the value of 1. All null values are given the value 2.
- ii) **Cost distance** – A cost distance grid is produced using a set function. This requires input of both the cost grid and a single class grid. The cost distance grid produced is only processed to a distance of 400 metres in order to save time.
- iii) **Reclass null values in cost distance grid** – All null values in the cost distance grid are reclassified to the highest value in the cost distance grid.
- iv) **Nearest Neighbour** – A 'sum' of nearest neighbour function is used on the cost distance grid.
- v) **Reclass values in nearest neighbour grid based on optimum threshold** – The user has to choose a suitable value that does not grow the grid too much but that smoothes the edges. All values below the threshold are given the original class value and all values above the threshold are given a null value.
- vi) **Repeat for all classes** – repeat steps i) to iv) for all classes in the original grid.

### 3. Merging of grown classes

This procedure consists of single step which involves the user rearranging the single class grids resulting from growing in an ArcView view. Once the user has chosen a suitable sequence of priority, a merge themes function is used to merge the grown grids into a new single grid theme.

### 4. Mosaic classes

This procedure involves a number of steps as follows:

- i) Removal of all LCMGB grid patches that are greater than 25 hectares.
  - a) **Region group** – Groups all pixels into parcels of a particular class.



- b) **Test for area > 25 hectares** – i.e. test to see whether each parcel is greater than 25 hectares. If the parcel is less than 25 hectares it is given a null value.
  - c) **Direct conversion** – directly convert the LCMGB codes to CORINE classes
- ii) From the remaining grid select polygons that are classes 20 and 21 (i.e. urban and suburban).
  - a) **Region group** – Groups all pixels into parcels.
  - b) **Test for area > 25 hectares** – i.e. test to see whether each parcel is greater than 25 hectares. If the parcel is less than 25 hectares it is converted to a null class.
  - c) **Direct conversion** – directly convert the landcover codes to corine class 1.1.2 (i.e. suburban).
- iii) From the remaining grid select out those polygons that are not of the LCMGB class 18, 20 and 21 (18: arable).
  - a) **Region group** – Groups all pixels into parcels.
  - b) **Test for area > 25 hectares** – i.e. test to see whether each parcel is greater than 25 hectares. If the parcel is less than 25 hectares it is given a null value.
  - d) **Majority conversion** – convert the parcel from LCMGB codes to corine codes using the majority component of LCMGB landcode contained in the parcel. This is carried out using the zonalstats class function in ArcView.
- iv) From the remaining grid:
  - a) **Region group** – Groups all pixels into parcels.
  - b) **Test for area > 25 hectares** – i.e. test to see whether each parcel is greater than 25 hectares. If the parcel is less than 25 hectares it is given a null value.
  - c) **Create polygon shapefile** – a polygon coverage is created for regions > 25 hectares (i.e. vector layer).
  - d) **Rule base conversion** – convert the region from landcover codes to corine codes using the mosaic rules shown in Fig 3. A zonal geometry table can be created in ArcView that shows the area composition in terms of LCMGB landuse class within each polygon created in step IV)c).

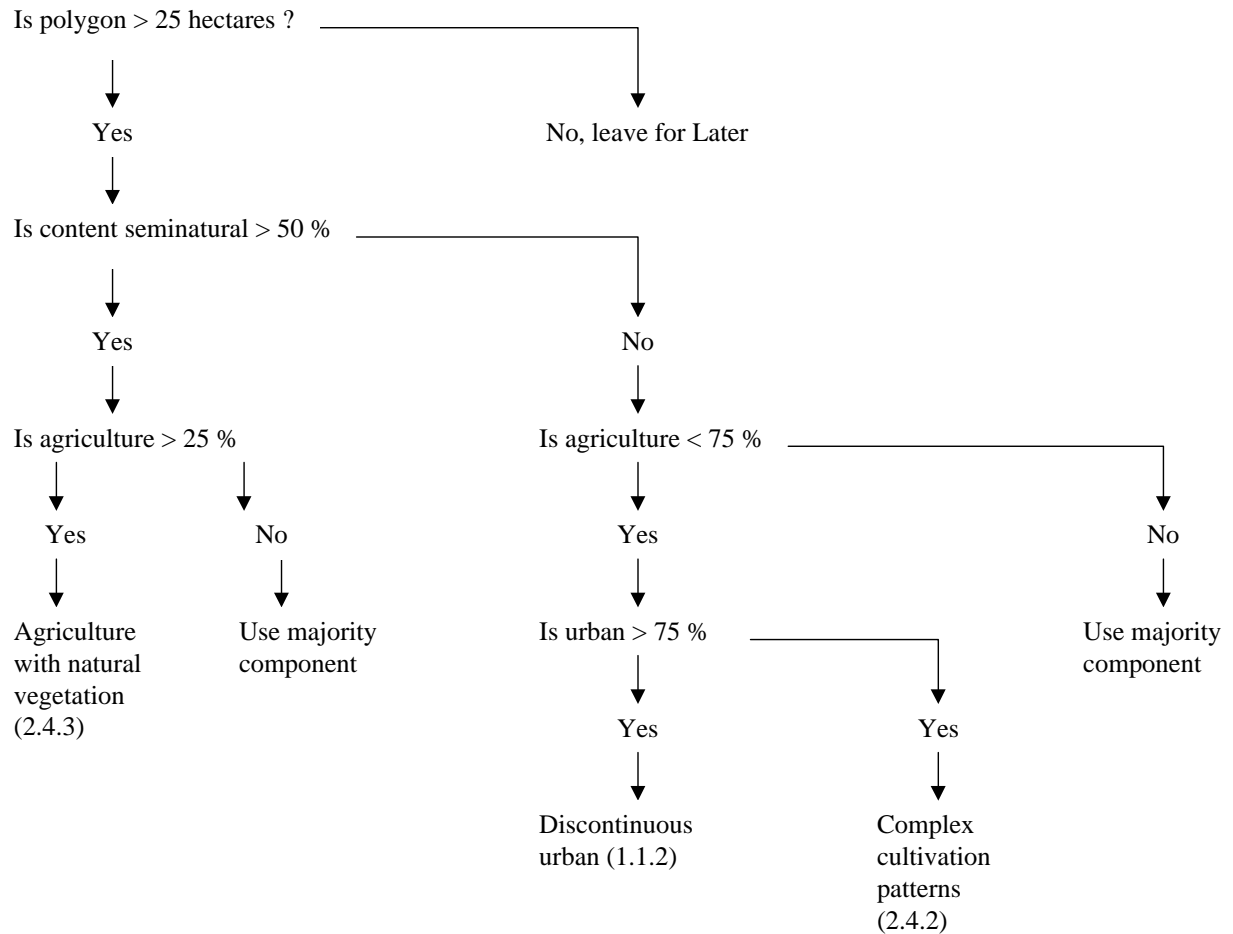


Fig 3: Schematic overview of rules used to assign mosaic parcels to Corine classes

**Semi-natural** – all LCMGB classes except 20, 21, 18

**Agriculture** – LCMGB class 18      **Urban** – LCMGB classes 20 and 21

## 5. Land Use data sources

See above – use of Bartholomews point data.

## 6. Smoothing

This has been decided to incorporate a Douglas Peucker and bend simplification function both to be executed in ArcInfo.